9. Deforestation, rainforests, reforestation and wetlands – natural carbon sinks.

Atmospheric CO_2 can be reduced naturally by its uptake into vegetation and soils. Any process which removes GHGs from the atmosphere is known as a sink. Human activities impact on terrestrial sinks through land use, land-use change and forestry (LULUCF). These can significantly alter the exchange of CO_2 (carbon cycle) between the terrestrial biosphere system and the atmosphere. Globally LULUCF accounts for 6% of global emissions

Deforestation.

As trees grow, they draw in CO_2 through their leaves, converting it into carbohydrates by photosynthesis, which are used as both an energy supply and the principle raw material, along with water, nitrogen and some trace elements for all new growth. While the tree survives, the carbon remains bound up and can remain that way for decades or centuries along with a similar mass of 'dead' organic matter undergoing decomposition on and in the soil beneath the trees.

Clearing forests (deforestation) results in the immediate loss of this capacity to act as a carbon sink; burning of the timber, surface debris and ending the supply of organic matter into the soil releases nearly all the stored carbon as CO_2. The loss of the complex web of associated organisms below ground also results in loss of the soil's ability to store water or recycle nutrients so both are lost to any regenerating natural community or crop.

The drivers for deforestation include conversion to pastureland for cattle, growing feedstocks for cattle, establishing monoculture-based plantations to produce palm oil, paper and timber, and urbanisation. Where timber or other crops are used as a biofuel they will reduce reliance on fossil fuels but will have no impact on reducing total atmospheric GHG levels, unless combustion is combined with, as yet unproven, carbon capture and storage processes.

Between 1990 and 2015 the world's forests decreased by 3.1%. In 2010 the world's forests and woodlands were estimated to store more than 485Gt of carbon which then decreased by an estimated 0.22Gt annually between 2011-2015.
Deforestation is a major source of CO_2 emissions since, when trees are cut down much of the stored carbon is lost when the wood is burned or decomposes. In 2017 land use changes, mostly deforestation, accounted for 10% of total global emissions of CO_2.

If we stopped cutting down trees our CO_2 emissions would be reduced by about 10%.

Rainforests.

Continued burning of the Amazon rainforests is causing concern that another climate tipping point 'Amazon die-back' could be reached. Climate models present different scenarios and researchers have debated the likelihood but fears have heightened under Brazil's new president, who advocates expansion of industry in the region.

The trees play an important part in the region's water system, taking in rainwater through their roots, moving it up into the canopy, and releasing it into the air, a process called evapotranspiration. The trees provide a mechanism for recycling water and generating rainfall which helps sustain agriculture throughout Brazil and top-up reservoirs supplying major cities. Eneas Salati, a Brazilian Scientist, demonstrated that the Amazon

produces roughly 50% of its own rainfall by recycling water through trees and other vegetation back up to the passing airmasses, essentially recharging them for rainfall in the next portion of the Amazon. Salati's results showed that, as the region's rivers flow from the Andes, east towards the Atlantic, these airmasses pass from east to west across the Amazon; the recycling of water occurs 5-6 times across that span. The concern is that loss of large areas of forest could disrupt this cycle resulting in further dieback through the loss of rainfall. Since 1970, 20.5% of the rain forest has disappeared; scientists indicate that losses between 20-25% could trigger the tipping point.

Reforestation.

The planting of trees to sequester carbon emissions was proposed by all the political parties in the 2019 general election. To be part of an effective emissions control strategy the trees and timber need to retain the carbon which has been sequestered and not release it back to the atmosphere. Monoculture plantations are much poorer at carbon sequestration than natural forests and the regular harvesting and clearing of plantations releases stored CO_2 every 10-20 years, whereas natural forests can continue to sequester carbon for many decades. The greater use of timber in building and construction would ensure carbon remained locked up for much longer. The best place to plant new trees is generally accepted to be in the tropics where trees grow fastest trapping the most CO_2.

Natural climate solutions, including restoring wetlands and other ecosystems, and minimising emissions from farmland, will all make significant contributions, but preserving existing forests and reforesting degraded areas provides the greatest opportunity to reduce emissions. Estimates of the potential impact vary but estimates are in the region of 11-15Gt of sequestered CO_2 per year.

In 2017 UK LULUCF was assessed as a net sink of 9.9Mt CO_2e emissions with emissions from cropland being more than balanced by forests acting as a sink. UK LULUCF has gone from being a small emitter in 1990 to a net sink over subsequent years due to a reduction in land being converted to cropland, less intensive agriculture and increasing uptake by newly planted trees.

Wetlands and Peatlands

Wetlands cover only 3% of the UK but are an important Carbon sink; their ability to sequester carbon is being considered in national GHG emissions assessments. Most of the world's soil carbon is held in wetlands but over a third of wetlands have disappeared since 1970. The ability of healthy wetlands to mitigate climate change far outweighs other terrestrial ecosystems.


Peat cutting, Scotland
Credit: Greg Morss / CC BY-SA 2.0

Peatlands, which cover about 3% of the earth's surface and 12% of the UK land surface, contain 550Gt of carbon, more than all the worlds forest combined. The year-round waterlogged conditions slow the process of plant decomposition to such an extent that dead plants accumulate to form peat. Large amounts of carbon, fixed from the atmosphere into plant tissues through photosynthesis, are locked away in peat soils, providing a valuable global carbon store. Over millennia this material builds up at the rate of about 1mm a year to produce layers several metres thick. Peatlands sequester around 0.37Gt of CO_2 per year storing more carbon than all other vegetation types combined. A lack of awareness of the role played by peatlands has led to their drainage and conversion for agriculture, mining as a fuel and use in horticulture. Some 15% of the world's peatlands have already been drained.

Virtually all of the carbon in the 4 billion tonnes of coal produced in 2018 was initially deposited as peat in tropical and subtropical wetlands. The majority of the deposition occurred during the Carboniferous period from 360M to 300M years ago when it was fortuitously buried under sediments from simultaneously adjacent eroding mountain chains. A peat depth of some 30 to 50 meters, which took 30,000 years to accumulate, is required per meter depth of coal seam.

When we examine the greenhouse emissions from the land use sector, 10% are derived from drained peatlands with emissions in the region of 1.3Gt of CO_2 annually, equivalent to 5.6% of global CO_2 emissions. While the UK has no rainforests, peatlands provide the closest natural environment we have for combating climate change, but in almost every garden centre you will find compost containing peat, bagged up ready for British gardeners to use, despite DEFRA, in 2010, giving the industry ten years to phase out the use of peat.

The Committee on Climate Change report to Parliament in June 2020 points out that although the UK LULUCF sector is currently recorded as a net carbon sink, when the carbon emissions from degraded peatland are included in future inventories it is expected to make the sector a net source of emissions. They indicate the need for significant upland and lowland peatland restoration (and sustainable management) due to their impact on climate change.